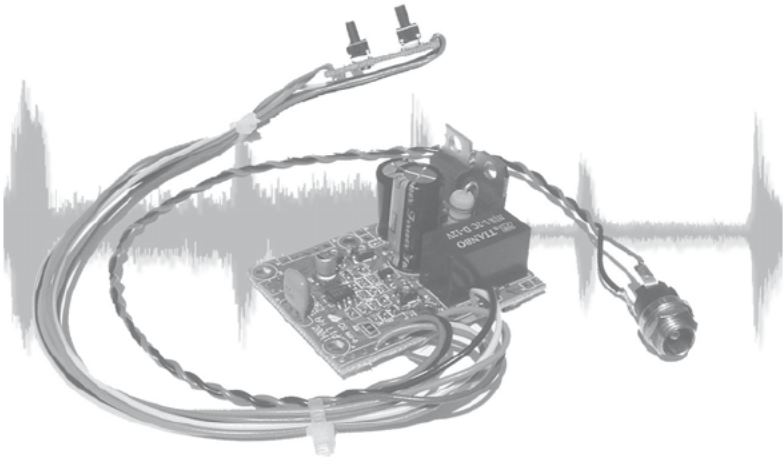
DSP Noise Cancelling Products from bhi

bhi

NEDSP1062 KBD

Amplified Noise Eliminating DSP Module

Installation and Operating Manual



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Issue E

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1. Introduction.

The **NEDSP1061-KBD** is a modular solution for noise reduction. It incorporates Digital Signal Processing (DSP) technology to provide up to 35dB of noise cancellation and 65dB of tone reduction. The module features an on board power amplifier to allow it to be easily incorporated in to existing equipment by installing the module in line with the loudspeaker. All functions of the module are controlled by an easy to use keyboard.

1.1 NEDSP1062-KBD module features:

- Fully adaptive noise cancellation up to 35dB
- Input and output level controls
- Input level over load indication
- Virtually no distortion to speech signal
- Easy to install
- Up to 8 levels of noise reduction (selectable)
- Frequency response 50Hz - 4.3KHz
- 3 Watts output (4Ω)
- Single button operation with LED and audible indication
- 12 - 18V supply range
- 27dB on board gain
- Power on/off - bypass pushbutton
- Small size 37 x 50mm (DSP pcb)
- Audio bypassed when power disconnected
- Supplied with fixing and wiring kit and all labels

1.2 Limitations.

This module is designed to pass speech. Other signals such as data, music and morse (CW) will to some degree pass through depending on the current filter level, but the integrity of these signals
cannot be guaranteed.

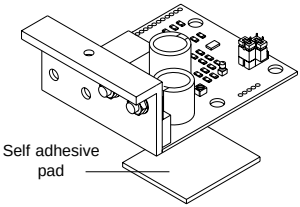
This module is designed to be driven from a high level signal, capable of driving a load of 22Ω.

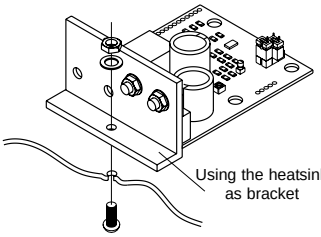
(The module can be easily modified to be driven from a low power signal, see section 3.3 for more information).

1.3 Module connection and mounting

The module is supplied with a pre-wired 2.1mm power connector. The centre pin is positive. The audio in and out are pre-wired pairs of wires, ready to be connected in the audio path. The heatsink doubles up as a mounting bracket.

The module can be mounted using the supplied self adhesive foam pad. Ensure that none of the circuit pins can make contact with any metallic parts.





For improved heat dissipation and a more rigid mechanical fixing the heatsink can be reversed and used as a bracket. Note that the heatsink is at 0V potential and therefore may have to be electrically insulated from any other metallic parts.

Alternatively the module has four fixing holes which allow it to be fixed to pillars.
(See section 6 for hole details and physical dimensions).

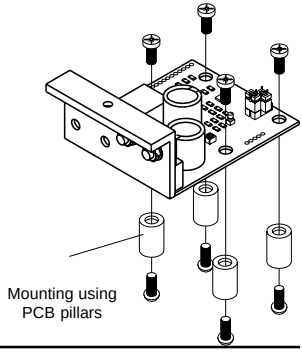


Figure 1. Mounting options

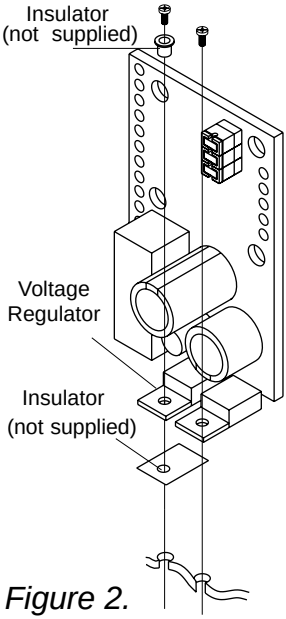


Figure 2.
Direct mounting.

If the installation has limited space, and is housed in a metal enclosure, the heatsink can be removed, and the module mounted directly on the chassis. The voltage regulator needs to be correctly insulated as the tab is connected to 0V. Insulate both the regulator and mounting screw. For improved heat dissipation use a suitable thermal paste between the power devices and the mounting.

1.4 Keyboard mounting.

The keyboard is mounted through the enclosure to provide an easy to use interface. The module is supplied with a label to place over the keyboard.

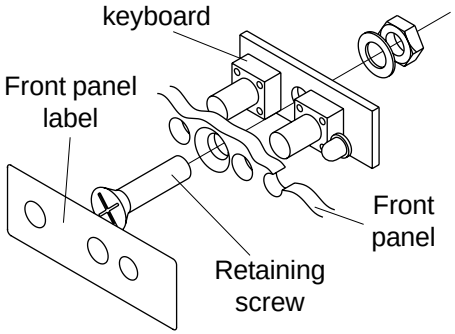


Figure 3. Keyboard mounting 1.

When the enclosure is thick enough the keyboard is retained using a countersunk screw (supplied), which is hidden by the label, see figure 3 above. Do not over tighten the mounting screw.

If the enclosure is too thin to incorporate a countersunk screw (such as fitting into sheet metal) then it can be retained by a instrument head screw.
The label needs to be cut out to allow the screw to pass through from the outside. This can be easily achieved by applying the label to the panel, then carefully cutting around the screw hole, with a sharp knife. Again do not over tighten the screw.

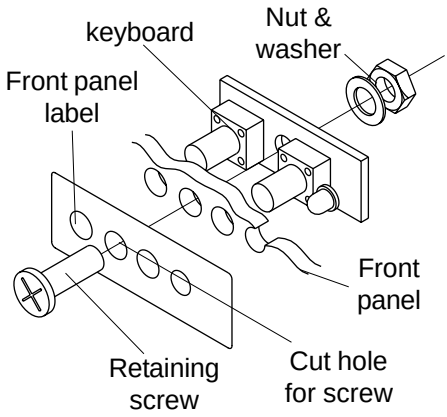


Figure 4.
Keyboard mounting 2.

1.5 Sounder mounting.

Cut a small piece of the self adhesive foam (supplied) to mount the sounder.
Do not cover the small hole in the face of the sounder.
For best results mount the sounder where it can radiate sound to the outside the case, for example on an air vent.

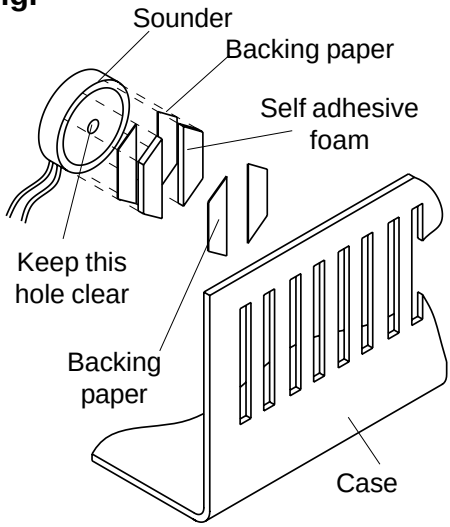
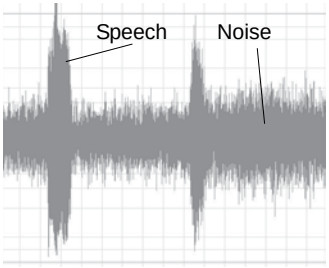


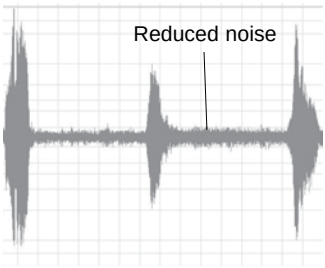
Figure 5. Sounder mounting

1.6 DSP Noise cancellation.

The bhi DSP processes the incoming signal and then differentiates the speech from the noise. The unwanted noise and interference is then attenuated to leave only the speech. The following diagrams are taken from actual audio signals and illustrate how the signal is being processed.



Original signal.
Speech with a lot of background noise



Processed speech.
Speech with reduced noise

Figure 6. Noise cancellation.

2. Module description.

2.1 Block diagram.

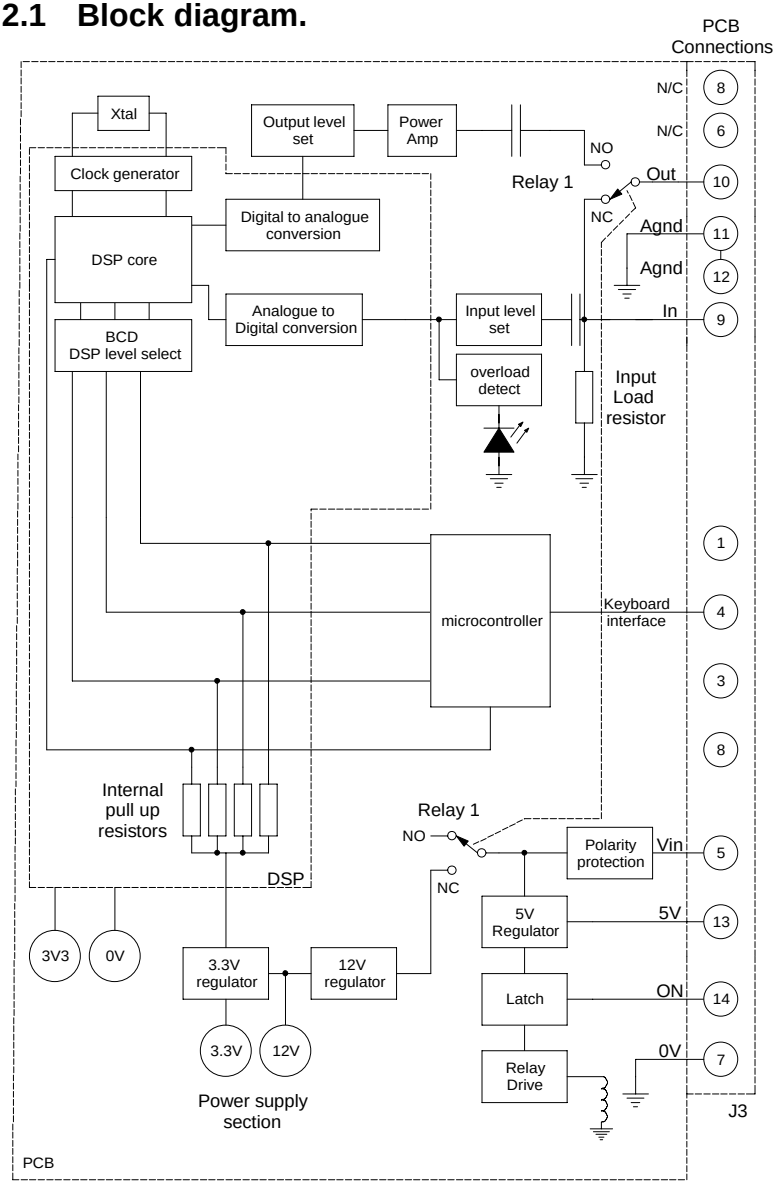


Figure 7. NEDSP1062-KBD block diagram

2.2 Module Layout.

The following diagram shows the layout of the **NEDSP1062-KBD** module.

Note:
Wiring obmitted for clarity

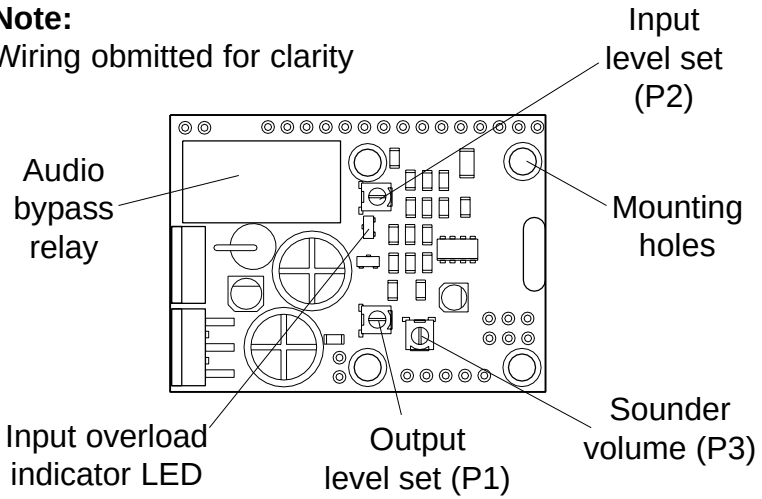


Figure 8. NEDSP1062-KBD connections and controls

2.3 Pin functions.

The following table gives a description of the pin functions.

Pin No.	Name	Description	Notes
4	N/C	Do not connect	Not used
5	Vin	Supply voltage	12 - 18VDC power in
6	N/C	Do not connect	Not used
7	0V	0V connection	0V power connections
9	In	Audio input	Audio signal in to be processed
10	Out	Audio output	Procesed audio signal out
11	Agnd	0V for input audio signal	Analogue ground for audio in
12	Agnd	0V for output audio signal	Analogue ground for audio out

Table 1. NEDSP1062 connection functions

2.4 Controls.

2.4.1 PCB.

The level controls provide adjustment for the audio levels entering and leaving the module. The modules are factory set to the maximum level.

Turning the potentiometers clock wise will decrease the levels. These potentiometers do not have end stops, so it is possible to set them in a position where the audio will be lost.

Audible indication of operation is provided by an piezo sounder. The volume of this sounder can be varied by potentiometer P3. The sounder volume is independent of the incoming audio volume.

2.4.2 Keyboard.

The keyboard controls all of the module functions including power on/off.

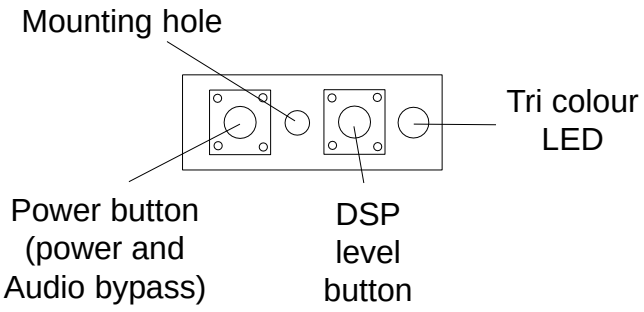


Figure 9. NEDSP1062-KBD keyboard.

2.5 Electrical characteristics.

ELECTRICAL CHARACTERISTICS

(V_s=16V, T_{amb}= 25°C unless otherwise stated)

DC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_s	Supply voltage		12	16	18	V
Iq_s	Quiescent current	V_s = 12V V_s = 16V V_s = 18V		4.6 6.8 7.1		mA
Iq_{on}	Quiescent current DSP on no load no signal	V_s = 12V V_s = 16V V_s = 18V		143 160 161		mA

AC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
P_o	Output power	d = 10% f = 1KHz R_L = 8Ω R_L = 4Ω	12V 1.16 1.7	16V	18V 2.06 3.17	V_s W W
V_i	Input sensitivty 4Ω load	f = 1KHz P_O = 0.5W P_O = 1.0W P_O = 2.0W			60 90 130	mV
V_i	Input sensitivty 8Ω load	f = 1KHz P_O = 0.5W P_O = 1.0W P_O = 2.0W			81 117 180	mV
B	Frequency response (-3dB)	P_o = 1W R_L = 8Ω	50		4300	Hz
d	Distortion	f = 1KHz P_O = 0.2 - 2.4W R_L= 8Ω P_O = 0.2 - 2.4W R_L= 4Ω		0.8 0.8		%
R_i	Input resistance		21	22	23	Ω
G_v	Voltage gain	f = 1KHz		27		dB
n	Efficiency	f = 1KHz P_O = 3W R_L = 4Ω P_O = 2W R_L = 8Ω		33 38		%

ANALOGUE CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max.	Units
T_d	System delay			26		mS

Table 2. Electrical characteristics 1

Figure 10. Frequency response

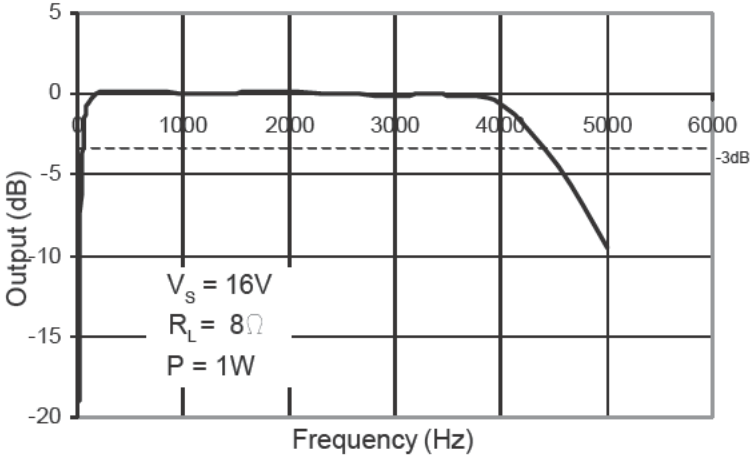


Figure 11. Distortion vs. Output power

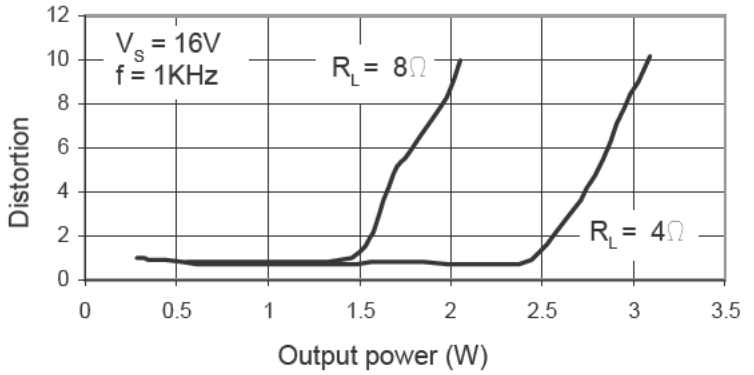
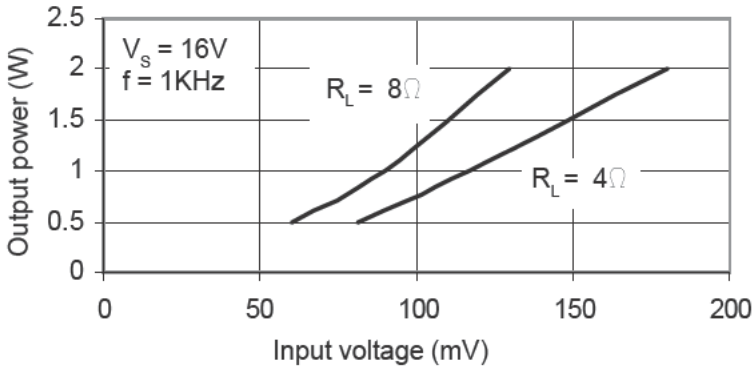


Figure 12. Sensitivity.



3. Installation

3.1 Installation overview.

The **NEDSP1062-KBD** module is inserted into the path of noisy audio. The input and output level controls allow the module to be fine tuned to suit most applications.

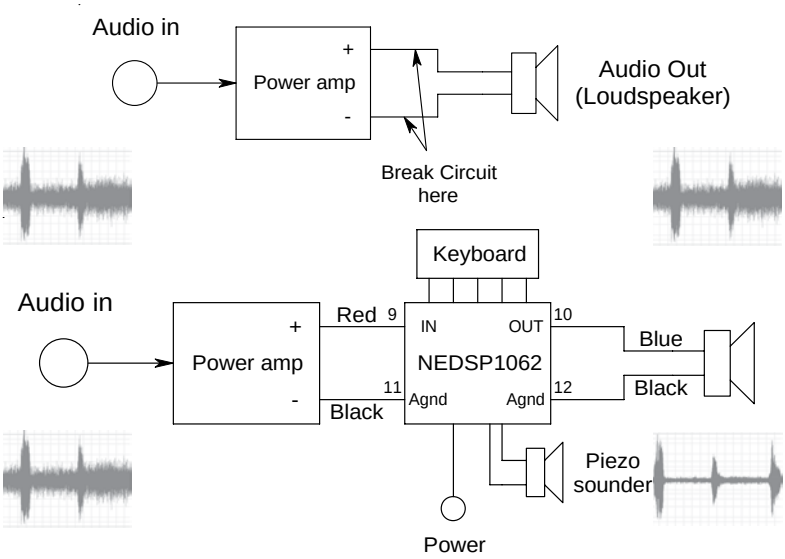


Figure 13. Basic connection diagram

The input to the module is loaded at 22Ω to provide a dummy load to the preceding circuit. This can be removed if required, such as using the module in applications where the audio source is provided by a low level, low power signal source. More information on this can be found in section 3.3 in this operating manual.

If V_{in} is less than approx. 13.8V ensure the power supply is well decoupled otherwise the power supply rejection ratio will deteriorate. Best results are obtained in the range of 13.8V - 16Vdc.

3.2 Module setup.

Both the input and output levels are adjustable on the module. This allows easy integration into the target system.

3.2.1 Overview.

To obtain the best results from the noise reduction the module should be set up to give optimum performance. The input sensitivity control has a range of 0.70mW - 3W to provide 2W (Ω) output.

Under certain conditions, RF breakthrough can sometimes occur. To minimize this, the input level (P2) may need to be reduced or go to the FAQ page on the bhi website and download the FAQ on RF breakthrough.

Under certain conditions the DSP can create a small amount of noise, normally when the unit has no signal applied. You should not be able to hear this noise when a signal is applied.

3.2.2 Suggested set up procedure:

Basic setup procedure.

- Connect input source and output device.
- Ensure the **NEDSP1062- KBD** is switched off.
- Set the audio source to a typical audio level.
- Switch on the **NEDSP1062- KBD**.
- Adjust the input control (P2) until the overload LED illuminates. Reduce the level by approx. 1/4 turn.
- Adjust the output level to the desired level.
- Hold down the DSP button and adjust the volume of the sounder to suit using P3.

3.2.3 Change to output load.

The audio input to the module is loaded at 22Ω. This load is effectively connected across the output load when the unit is switched off (bypassed).
This will reduce the impedance presented to the audio source.

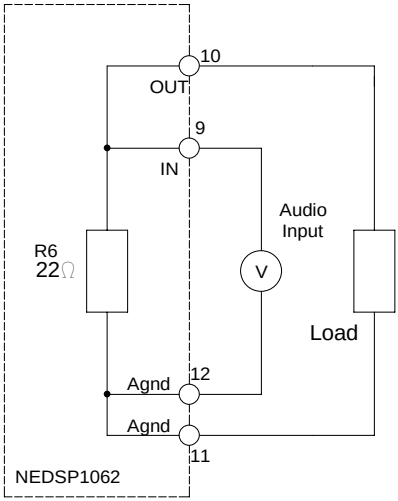


Figure 14. Input circuit - module powered down

For example:
8Ω will reduce to 5.9Ω
4Ω will reduce to 3.4Ω

3.2.4 Other signal considerations.

The **NEDSP1062- KBD** requires a signal of 125mV rms or greater for optimum performance. Signals lower than this may be used but the noise cancellation performance will decrease, as the signal levels drops. If the unit is used with low level signals such as microphones, the signal will need amplifying before applying it to the **NEDSP1062- KBD**.

Due to the adaptive nature of the noise cancellation a small delay may be heard when the audio signal changes. For optimum performance provide the module with a constant signal where possible.

When switching on the unit a thump may be heard in the loudspeaker.

3.3 Driving from a low signal source.

The input to the module has a low impedance. This is to provide correct loading to any power circuits driving it. If the module needs to be driven from a low power signal then it must be modified in the following manner.

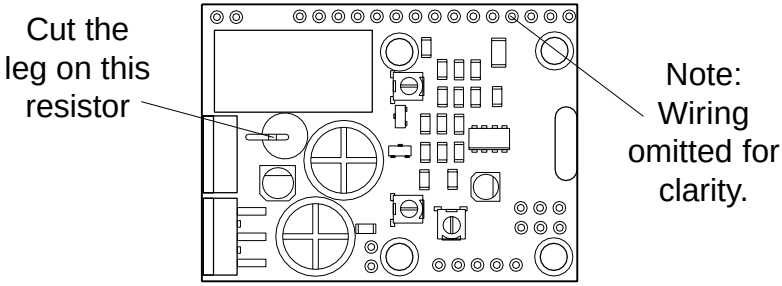


Figure 15. Physical modification for low power signal drive.

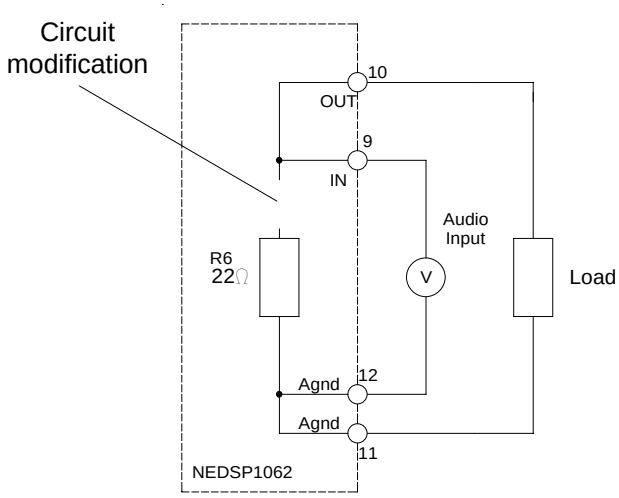


Figure 16. Circuit modification for low power signal drive.

4. Operation.

4.1 Keyboard.

The keyboard has 2 buttons and a tricolour LED.

4.1.1 Power button.

The power button switched the module on and off. When the module is off, the audio bypasses the module, so the circuit will behave as if the module isn't present. Switching the power on routes the audio through the module.

Note: If the power is on and the DSP is switched off, the audio still passes through the DSP - but without any signal processing.
A single press on the button switches on, and a single press will switch off. Also with the power connected and the module switched off the circuit will still draw 6mA.

4.1.2 DSP level button.

This button is used to set the following:

- DSP on/off
- DSP level
- 4 or 8 levels of noise cancellation
- Demonstration modes

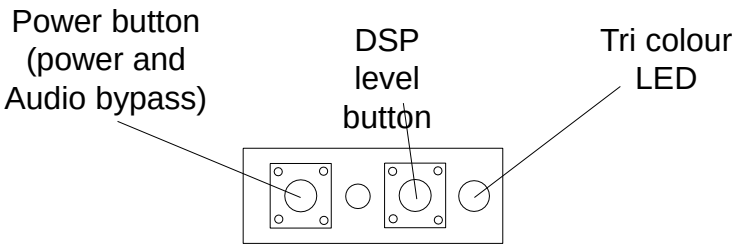


Figure 17. NEDSP1062-KBD keyboard.

4.2 Set up.

The following flow chart shows the functions of the DSP button.

Holding down the DSP button when switching on causes the module to enter the set up mode.

This is indicated by a 2 tone beep.

Releasing the DSP button at this point the module goes in to demonstration mode 1

Releasing the DSP button at this point the module goes in to demonstration mode 2

Keep the button down until the desired level has been reached, then release the button. The module will continously scroll through 4 and 8 levels until the button is released.

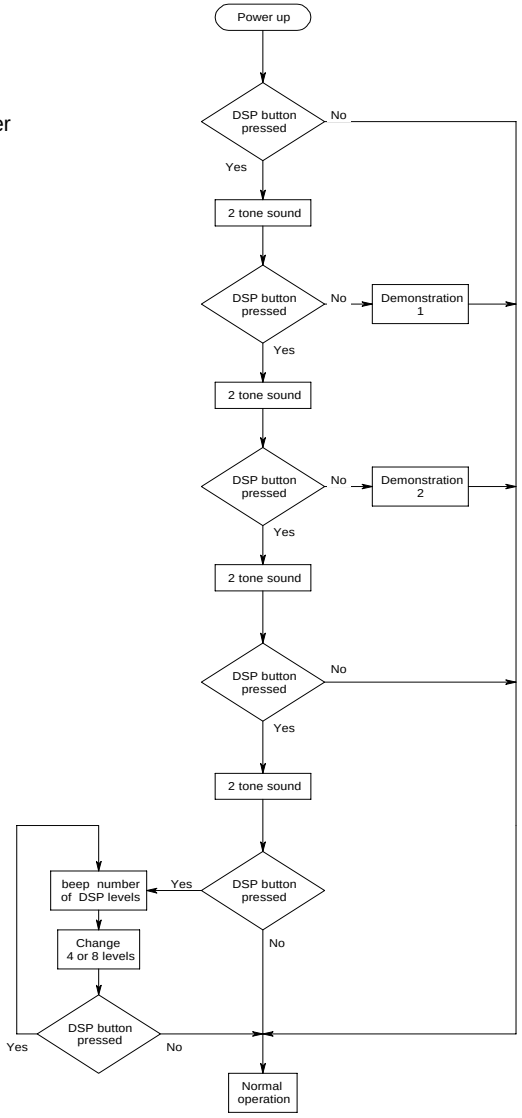


Figure 18. 4/8 level setting.

To listen to the demonstration modes, or change the number of DSP levels it is necessary to put the module into the set up mode.

To do this, ensure the module is Off. Press and hold the DSP level button. Turn on the module and a 2 tone beep will be heard indicating that the module is in the set up mode.

Releasing the button after the first 2 tone beep will enter demonstration mode 1.

Releasing after the second 2 tone beep will enter demonstration mode 2.

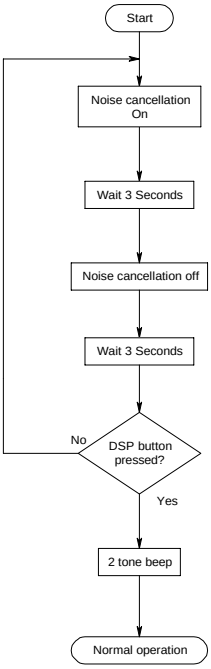
Keeping the button depressed with change the number of levels available. 4 beeps will indicate 4 level mode and 8 beeps 8 levels. Release the button when the desired level is reached.

The module will return to normal operation after this.
The colour of the LED will indicate the mode of operation.

DSP mode	4 Levels	8 Levels
OFF	RED	ORANGE
ON	GREEN	GREEN

Table 3. LED mode indication.

4.3 Demonstration modes.



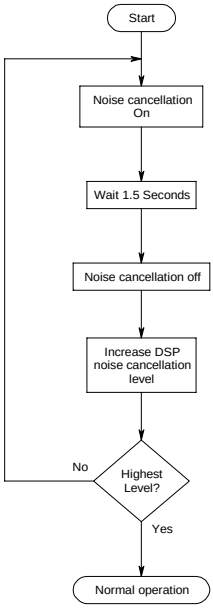


Figure 19. Demonstration modes.

Demonstration 1.

The module switches the noise cancellation on for 1.5 seconds, then off for 1.5 seconds. It will then move to the next level and repeat the process.

This mode is particularly effective at demonstrating the different DSP levels.

Alternatively pass a clean audio signal through the module to see hear how little the DSP alters the speech.

Demonstration 2.

The module switches the noise cancellation on for 3 seconds then off for 3 seconds. This is a good demonstration of the before and after effects of removing the noise.

Note:

To exit the demonstration modes hold down the DSP button until a 2 tone beep is heard.

4.4 Noise reduction levels.

4 or 8 levels of noise reduction are available. The amount of noise and tone reduction is shown in the table below.

Level (4)	Level (8)	Tone Reduction	White Noise Reduction
	1	4dB	9dB
1	2	5dB	11dB
	3	6dB	13dB
2	4	8dB	15dB
	5	16dB	17dB
3	6	21dB	20dB
	7	25dB	24dB
4	8	65dB	35dB

Table 4. Tone and noise reduction levels.

The column marked level (4) shows the noise and tone reduction when operating the module with 4 levels, and the level (8) column for 8 levels.

Holding down the DSP select button will continuously change the DSP level. When the desired level has been reached, release the button. The module will retain this level until it is changed.

5. Application Notes.

This section provides information on installing the **NEDSP1062-KBD** into various extension speaker units. Information on other speaker installs can be found at www.bhi-ltd.com, Amateur Radio Installs.

5.1 Yaesu SP8.

This section describes the general fitting of the **NEDSP1062-KBD** module in the Yaesu SP8 loudspeaker. This installation retains the operation of the internal filters.

Figure 20. NEDSP1062-KBD installed in a Yaesu SP8.

Suggested location for mounting the power connector

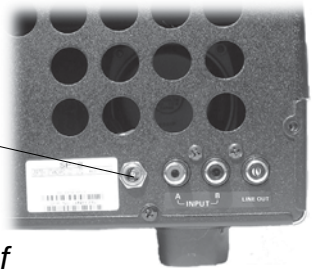


Figure 21. Suggested location of power connector

This photograph shows the suggested location for mounting the keyboard.

Figure 22. Suggested location of keyboard.

The **NEDSP1062** module in this application is inserted between the filter unit and the phone jack unit. Locate the 2 wire connector on the switch unit (JP2002). Break the wire to pin 1 and wire as shown in the diagram. Insulate the connection with the supplied rubber sleeve. Break the wire on pin 2 on JP2002 and connect as shown in the diagram and again insulate with a rubber sleeve. The fitting kit includes cable ties to tidy up the wiring of the installation. The photograph on the next page shows the complete installation. Mount the keyboard and power connector as shown elsewhere in this manual. The square bhi label can be fitted to the top of the case.

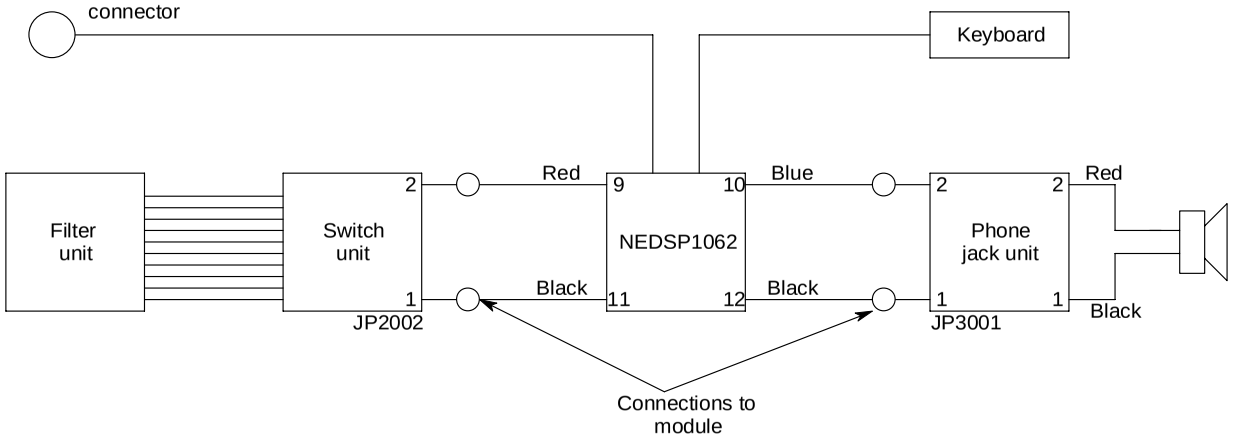


Figure 23. Circuit diagram of installation in Yaesu SP8.

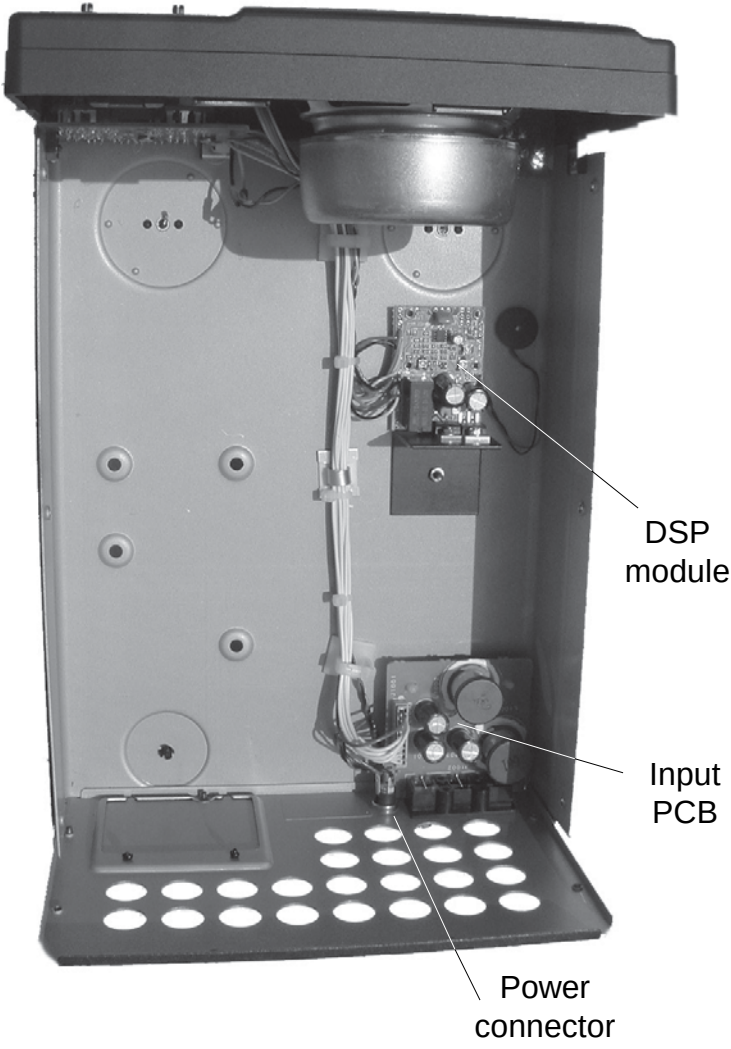


Figure 24. Complete installation in the Yaesu SP8.

5.2 Kenwood SP31.

This section describes the general fitting of the **NEDSP1062-KBD** module in the Kenwood SP31 loudspeaker. This installation retains the operation of the internal filters.

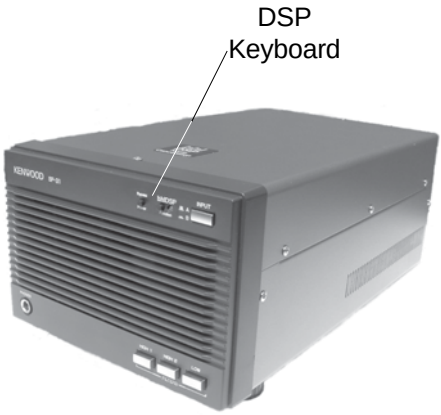


Figure 25. NEDSP1062-KBD installed in a Kenwood SP31.

This photograph shows the suggested location for mounting the keyboard.

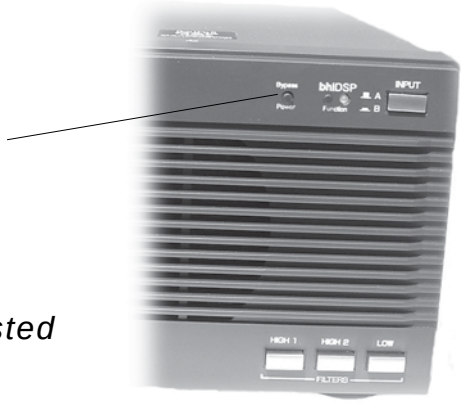
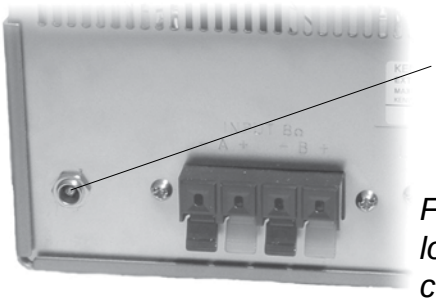


Figure 26. Suggested location of keyboard.



Suggested location for mounting the power connector

Figure 27. Suggested location of power connector.

The module is inserted into the circuit before the filter PCB. Identify the yellow wire connecting the input selector switch to the filter board. Break the wire and connect the **NEDSP1062-KBD** as shown below. Insulate the wires with the supplied rubber sleeves. Identify the black wire from the input PCB and connect as shown below, again insulating the connections. The fitting kit includes cable ties to tidy up the wiring of the installation. The photograph on the next page shows the complete installation. Mount the keyboard and power connector as shown elsewhere in this manual. The square bhi label can be fitted to the top of the case.

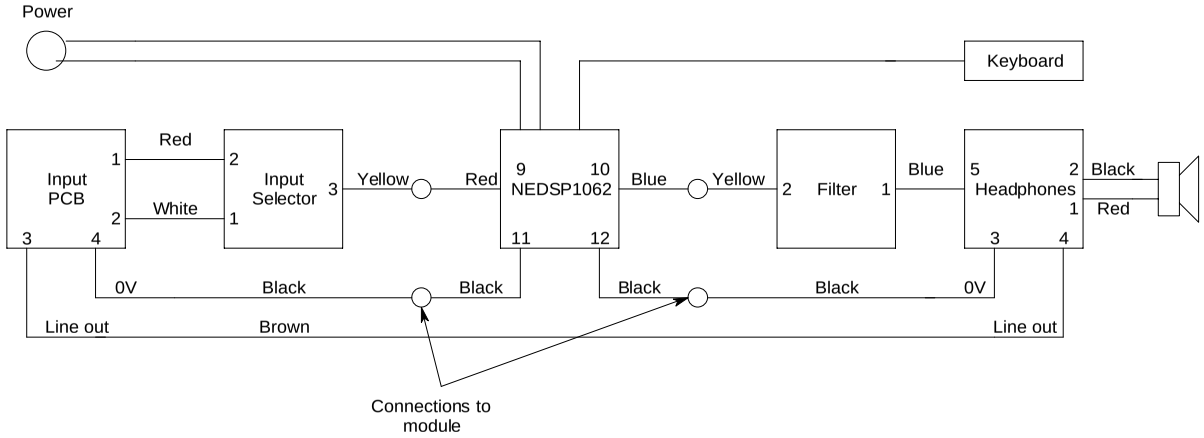


Figure 28. Circuit diagram of installation in Kenwood SP31.

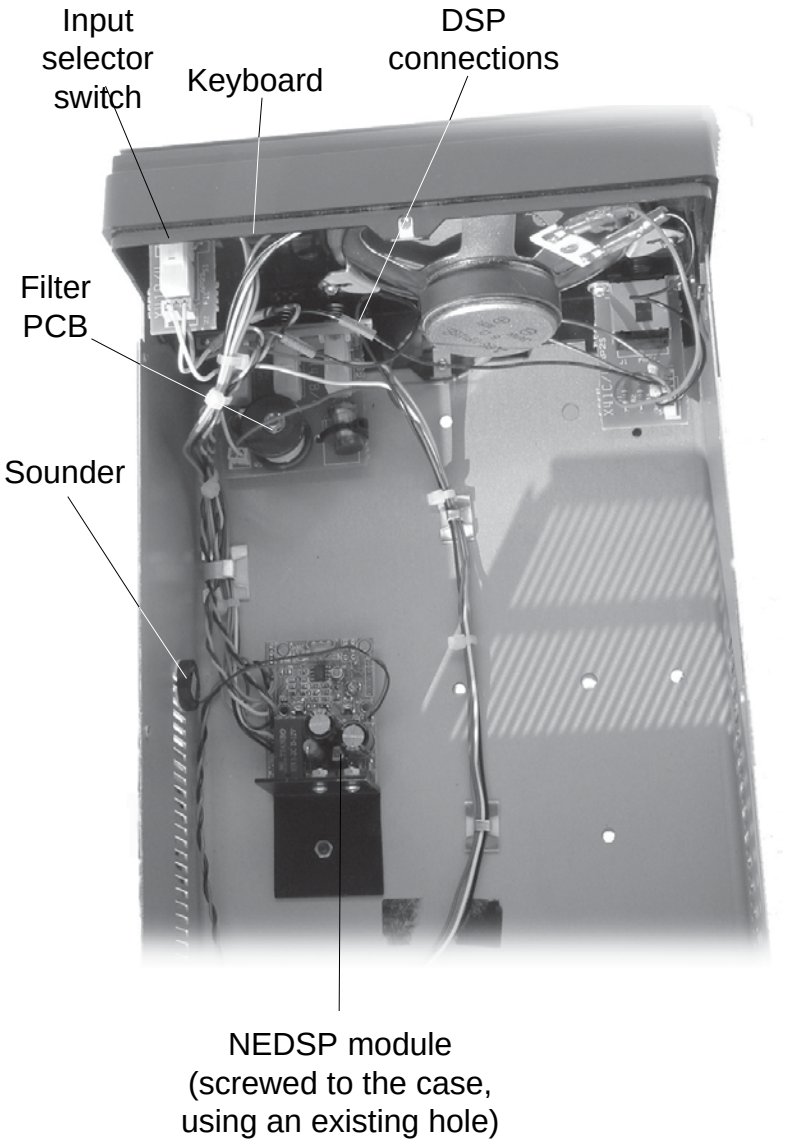


Figure 29. Photograph of complete installation.

5.3 bhi Label.

Supplied with the module is a square bhi label. Fix the label on the top of the speaker enclosure as shown.

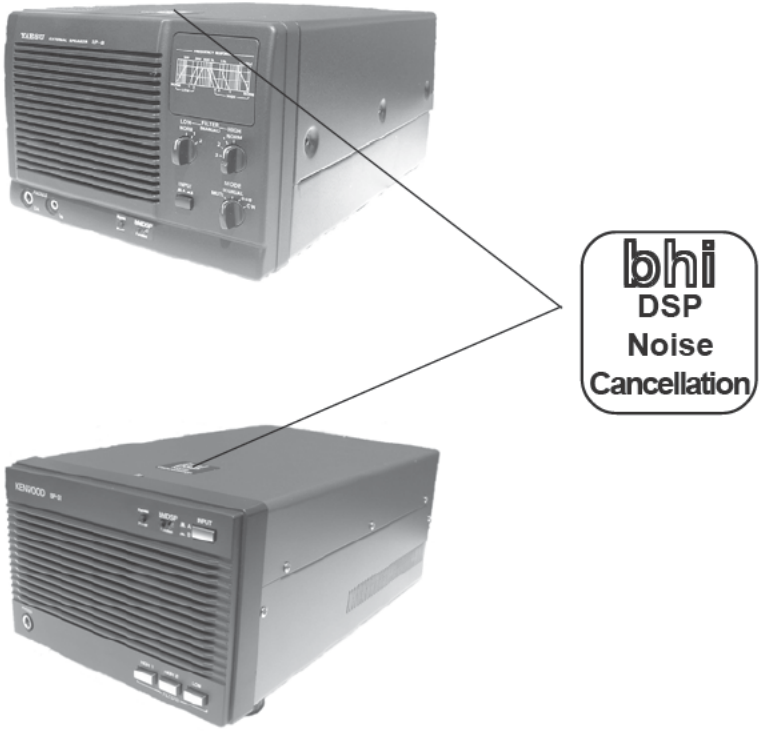


Figure 30. bhi label.

6. Physical Dimensions

6.1 Physical dimensions.

The following diagrams detail the physical dimensions of the module. All dimensions are in mm.

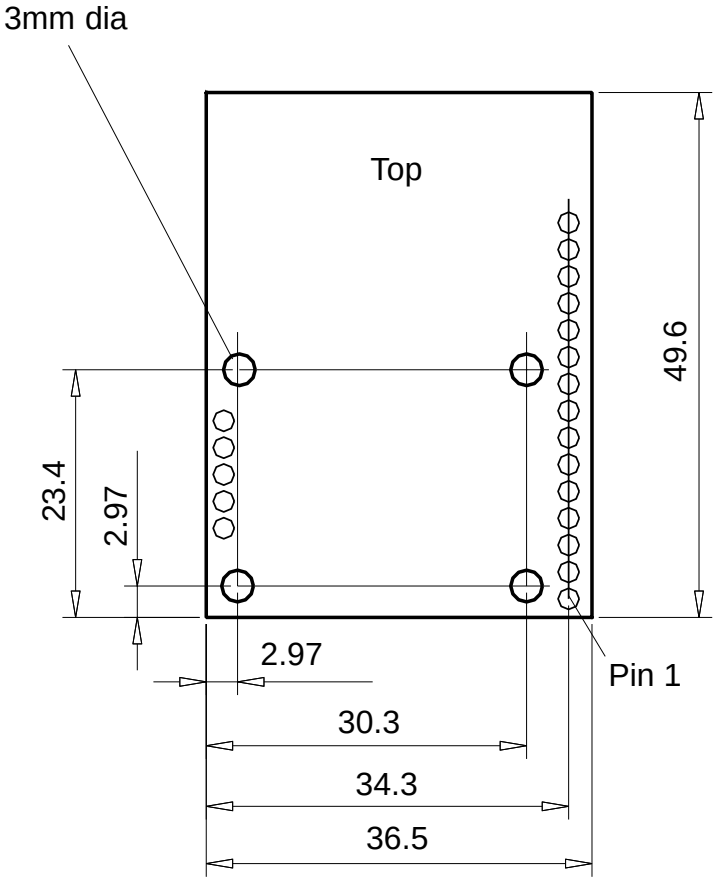


Figure 31. Mounting hole positions.

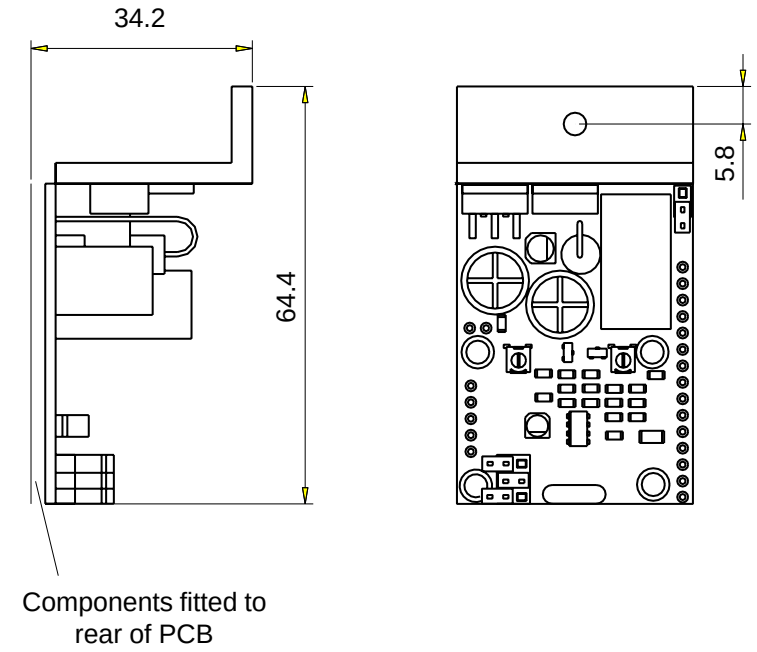


Figure 32. Overall dimensions.

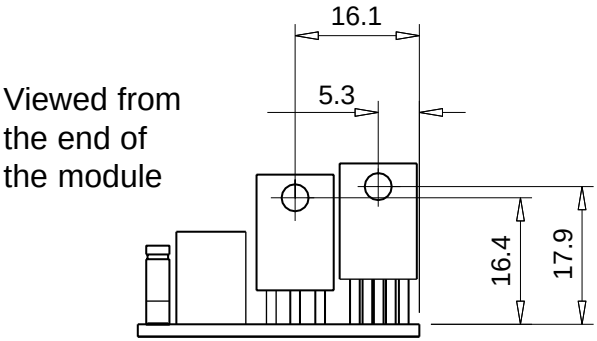


Figure 33. Hole dimensions of power devices - for direct mounting applications.

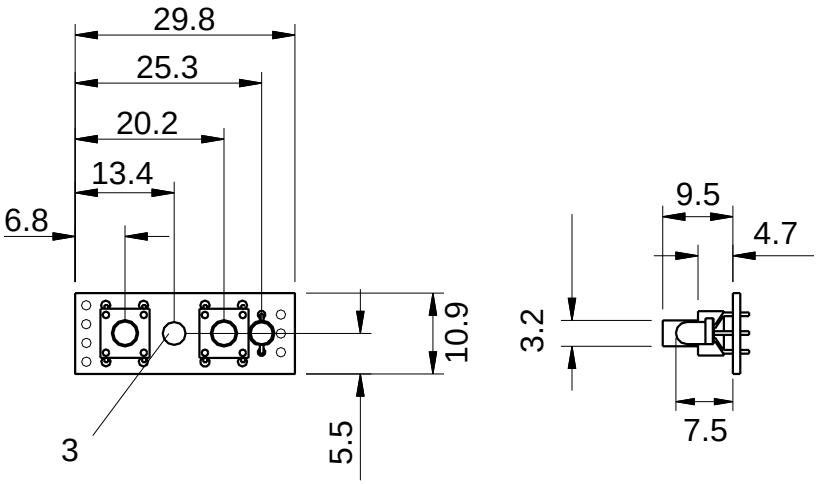


Figure 34. Keyboard dimensions.

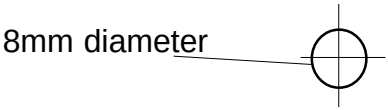
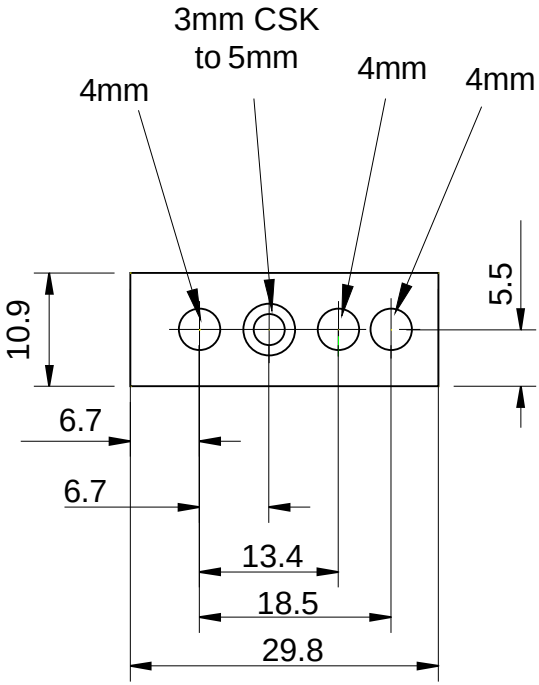


Figure 35. Power connector hole size.

6.2 Template.

The following drawing shows the sizes and positions of holes for the keyboard.



Not to scale
all dimensions in mm

Figure 36. Keyboard drilling detail .

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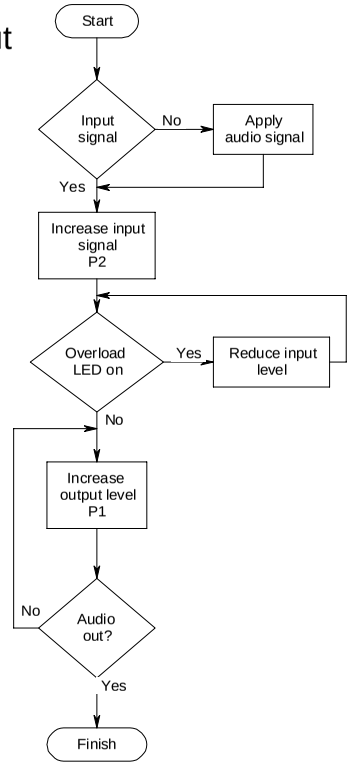
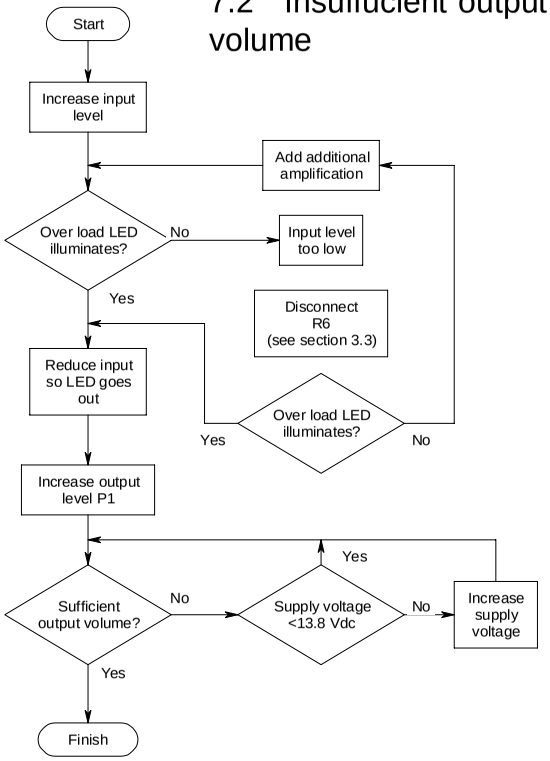
7.1 No audio out



7.2 Insuffucient output volume



7. Troubleshooting.

8. Other bhi products

Other noise cancellation products from bhi. Visit www.bhi-ltd.com for more information:

8.1 NES10-2 MK3 Noise Eliminating speaker.

Amplified DSP noise cancellation speaker with new rotary filtter select knob and increased audio power.

Features:

- Fully adaptive noise cancellation 9 -35dB
- 8 user selectable noise cancellation levels
- Mono earpiece socket
- Input sensitivity control
- Noise cancellation On/Off switch
- LED indication of power and noise cancellation
- 12-24VDC operation
- On/Off audio bypass switch.
- Easy to install with adjustable mounting bracket
- 2m audio lead
- Optional extras avaiable.

8.2 DSPKR

Loud10 Watt rms audio DSP noise cancelling speaker

Features:

- 7 DSP filter levels 9 - 24dB
- 12-18V DC operation
- Simple control of all functions
- sleep mode - Filter store function
- Volume control - Input level indicator
- Comes with 2m audio lead, Fused DC power lead & manual

8.3 NEIM1031 MKII In-line module.

Then **NEIM1031MKII** provides a flexible solution to noise reduction. It features both amplified inputs and outputs, along with line level signal processing. The unit also features an audio bypass when the unit is switched off, so there is no need to disconnect when not in use.

Features:

- Fully adaptive noise cancellation 9 -35dB
- 8 user selectable noise cancellation levels
- Mono earpiece socket
- Input sensitivity control
- Noise cancellation On/Off switch
- Line level in/out
- Input overload indication
- Power on/off with audio bypass.

8.4 NEIM1031 accessories.

LSPKR
20 Watt extension speaker for use with the NEIM1031. Fitted with a 3.5mm mono jack plug.

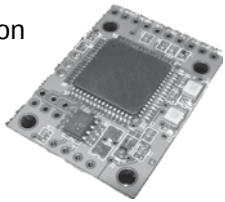
ANEM MKII
Compact in-line DSP noise cancelling module - Simple control - Use with Headphones or a speaker - 8 filter levelsSupplied with ALD-001, 1030-FPL and user manual.

8.5 DSP modules.

DSP module range.

NEDSP1061- KBD: Low signal level module controlled by single button keyboard.

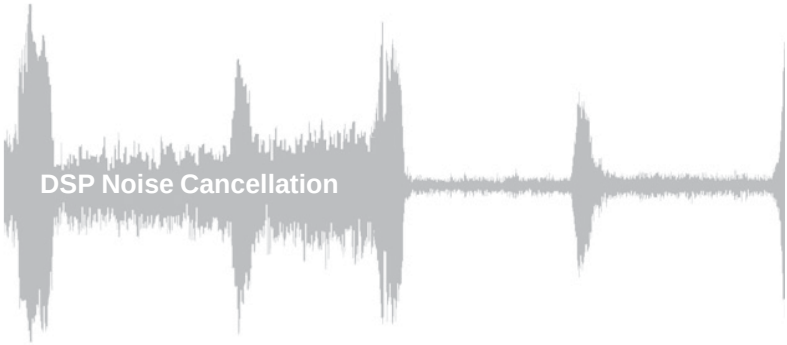
NEDSP1062 - KBD: Amplified DSP module controlled by a 2 button keyboard.



1030-UKPA UK DC power adapter
1030-EUPA European DC power adapter

DSP Noise Cancelling products from bhi

bhi



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